

CLAIMS

1. A power output apparatus that outputs power to a drive shaft, said power output apparatus comprising:

5 an internal combustion engine;

an electric power-mechanical power input-output module that is linked with an output shaft of said internal combustion engine and with said drive shaft and outputs at least part of power from said internal combustion engine to said drive shaft
10 through inputs and outputs of electric power and mechanical power;

a motor that is capable of inputting and outputting power from and to said drive shaft;

an accumulator that is capable of supplying and receiving
15 electric power to and from said electric power-mechanical power input-output module and said motor;

a power demand setting module that sets a power demand required to said drive shaft, in response to an operator's manipulation;

20 a target power setting module that sets a target power to be output from said internal combustion engine, based on the setting of the power demand;

a drive restriction effectuation module that, when a predetermined restricting condition is fulfilled, effects a
25 drive restriction of said motor based on the predetermined restricting condition;

a correction module that corrects the setting of the target power based on the effected drive restriction, when the drive restriction of said motor is effected by said drive restriction effectuation module; and

5 a control module that executes normal control of controlling said internal combustion engine, said electric power-mechanical power input-output module, and said motor in the case of no effectuation of the drive restriction of said motor by said drive restriction effectuation module to ensure
10 output of the target power from said internal combustion engine and output of a power corresponding to the setting of the power demand to said drive shaft, said control module executing restriction control of controlling said internal combustion engine, said electric power-mechanical power input-output
15 module, and said motor in the case of effectuation of the drive restriction of said motor by said drive restriction effectuation module to ensure output of the corrected target power from said internal combustion engine and output of a power in a range of the effected drive restriction from said motor.

20 2. A power output apparatus in accordance with claim 1, said power output apparatus further comprising:

 a charge-discharge electric power measurement module that measures a charge-discharge electric power used to charge said accumulator or obtained by discharging said accumulator;
25 and

 an electric power demand setting module that sets an

electric power demand for charging or discharging said accumulator, based on a predetermined charge-discharge condition,

wherein said correction module corrects the setting of
5 the target power to cancel a difference between the charge-discharge electric power measured by said charge-discharge electric power measurement module and the electric power demand set by said electric power demand setting module.

10 3. A power output apparatus in accordance with claim 1, wherein said target power setting module specifies a target torque and a target revolution speed to set the target power, and

said correction module varies the specified target
15 revolution speed to correct the target power.

4. A power output apparatus in accordance with claim 1, wherein said control module executes the restriction control on a condition that the power demand is in a predetermined light load power range, when the drive restriction of said motor is
20 effected by said drive restriction effectuation module.

5. A power output apparatus that outputs power to a drive shaft, said power output apparatus comprising:

an internal combustion engine;

an electric power-mechanical power input-output module
25 that is linked with an output shaft of said internal combustion engine and with said drive shaft and outputs at least part of

power from said internal combustion engine to said drive shaft through inputs and outputs of electric power and mechanical power;

a motor that is capable of inputting and outputting power
5 from and to said drive shaft;

an accumulator that is capable of supplying and receiving electric power to and from said electric power-mechanical power input-output module and said motor; and

a control module that sets a power demand required to
10 said drive shaft in response to an operator's manipulation and sets a target power to be output from said internal combustion engine based on the setting of the power demand, said control module controlling said internal combustion engine, said electric power-mechanical power input-output module, and said
15 motor in the case of no fulfillment of a predetermined restricting condition to ensure output of the target power from said internal combustion engine and output of a power corresponding to the power demand to said drive shaft, in the case of fulfillment of the predetermined restricting condition,
20 said control module effecting a drive restriction of said motor based on the predetermined restricting condition, correcting the setting of the target power based on the effected drive restriction, and controlling said internal combustion engine, said electric power-mechanical power input-output module, and
25 said motor to ensure output of the corrected target power from said internal combustion engine and output of a power in a range

of the effected drive restriction from said motor.

6. A power output apparatus in accordance with any one of claims 1 through 5, wherein said electric power-mechanical power input-output module comprises:

5 a three-shaft power input-output assembly that is connected with three shafts, that is, said output shaft of said internal combustion engine, said drive shaft, and a third shaft, and specifies input and output of power from and to one residual shaft among said three shafts, based on powers input and output
10 from and to two shafts among said three shafts; and

 a generator that inputs and outputs power from and to said third shaft.

7. A power output apparatus in accordance with any one of claims 1 through 5, wherein said electric power-mechanical
15 power input-output module comprises a pair-rotor generator having a first rotor, which is linked with the output shaft of said internal combustion engine, and a second rotor, which is linked with said drive shaft and rotates relative to the first rotor, said pair-rotor generator outputting at least part
20 of the power from said internal combustion engine to said drive shaft through input and output of electric power by electromagnetic interaction between the first rotor and the second rotor.

8. An automobile, comprising:

25 an internal combustion engine;

 an electric power-mechanical power input-output module

that is linked with an output shaft of said internal combustion engine and with a drive shaft coupled with an axle and outputs at least part of power from said internal combustion engine to said drive shaft through inputs and outputs of electric power
5 and mechanical power;

a motor that is capable of inputting and outputting power from and to said drive shaft;

an accumulator that is capable of supplying and receiving electric power to and from said electric power-mechanical power
10 input-output module and said motor;

a power demand setting module that sets a power demand required to said drive shaft, in response to an operator's manipulation;

a target power setting module that sets a target power
15 to be output from said internal combustion engine, based on the setting of the power demand;

a drive restriction effectuation module that, when a predetermined restricting condition is fulfilled, effects a drive restriction of said motor based on the predetermined
20 restricting condition;

a correction module that corrects the setting of the target power based on the effected drive restriction, when the drive restriction of said motor is effected by said drive restriction effectuation module; and

25 a control module that executes normal control of controlling said internal combustion engine, said electric

power-mechanical power input-output module, and said motor in the case of no effectuation of the drive restriction of said motor by said drive restriction effectuation module to ensure output of the target power from said internal combustion engine and output of a power corresponding to the setting of the power demand to said drive shaft, said control module executing restriction control of controlling said internal combustion engine, said electric power-mechanical power input-output module, and said motor in the case of effectuation of the drive restriction of said motor by said drive restriction effectuation module to ensure output of the corrected target power from said internal combustion engine and output of a power in a range of the effected drive restriction from said motor.

9. An automobile in accordance with claim 8, said automobile further comprising:

a charge-discharge electric power measurement module that measures a charge-discharge electric power used to charge said accumulator or obtained by discharging said accumulator; and

an electric power demand setting module that sets an electric power demand for charging or discharging said accumulator, based on a predetermined charge-discharge condition,

wherein said correction module corrects the setting of the target power to cancel a difference between the charge-discharge electric power measured by said

charge-discharge electric power measurement module and the electric power demand set by said electric power demand setting module..

10. An automobile in accordance with claim 8, wherein
5 said target power setting module specifies a target torque and a target revolution speed to set the target power, and

said correction module varies the specified target revolution speed to correct the target power.

11. An automobile in accordance with claim 8, wherein
10 said control module executes the restriction control on a condition that the power demand is in a predetermined light load power range, when the drive restriction of said motor is effected by said drive restriction effectuation module.

12. An automobile comprising:

15 an internal combustion engine;

an electric power-mechanical power input-output module that is linked with an output shaft of said internal combustion engine and with said drive shaft coupled with an axle and outputs at least part of power from said internal combustion
20 engine to said drive shaft through inputs and outputs of electric power and mechanical power;

a motor that is capable of inputting and outputting power from and to said drive shaft;

an accumulator that is capable of supplying and receiving
25 electric power to and from said electric power-mechanical power input-output module and said motor; and

a control module that sets a power demand required to said drive shaft in response to an operator's manipulation and sets a target power to be output from said internal combustion engine based on the setting of the power demand, said control
5 module controlling said internal combustion engine, said electric power-mechanical power input-output module, and said motor in the case of no fulfillment of a predetermined restricting condition to ensure output of the target power from said internal combustion engine and output of a power
10 corresponding to the power demand to said drive shaft, in the case of fulfillment of the predetermined restricting condition, said control module effecting a drive restriction of said motor based on the predetermined restricting condition, correcting the setting of the target power based on the effected drive
15 restriction, and controlling said internal combustion engine, said electric power-mechanical power input-output module, and said motor to ensure output of the corrected target power from said internal combustion engine and output of a power in a range of the effected drive restriction from said motor.

20 13. An automobile in accordance with any one of claims 8 through 12, wherein said electric power-mechanical power input-output module comprises:

a three-shaft power input-output assembly that is connected with three shafts, that is, said output shaft of said
25 internal combustion engine, said drive shaft, and a third shaft, and specifies input and output of power from and to one residual

shaft among said three shafts, based on powers input and output from and to two shafts among said three shafts; and

a generator that inputs and outputs power from and to said third shaft.

5 14. An automobile in accordance with any one of claims 8 through 12, wherein said electric power-mechanical power input-output module comprises a pair-rotor generator having a first rotor, which is linked with the output shaft of said internal combustion engine, and a second rotor, which is linked
10 with said drive shaft and rotates relative to the first rotor, said pair-rotor generator outputting at least part of the power from said internal combustion engine to said drive shaft through input and output of electric power by electromagnetic interaction between the first rotor and the second rotor.

15 15. A control method for a power output apparatus, which comprises: an internal combustion engine; an electric power-mechanical power input-output module that is linked with an output shaft of said internal combustion engine and with a drive shaft and outputs at least part of power from said
20 internal combustion engine to said drive shaft through inputs and outputs of electric power and mechanical power; a motor that is capable of inputting and outputting power to and from said drive shaft; and an accumulator that is capable of supplying and receiving electric power to and from said
25 electric power-mechanical power input-output module and said motor,

said control method comprising the steps of:

(a) setting a power demand required to said drive shaft,
in response to an operator's manipulation;

(b) setting a target power to be output from said internal
5 combustion engine, based on the setting of the power demand;

(c) when a predetermined restricting condition is
fulfilled, effecting a drive restriction of said motor based
on the predetermined restricting condition;

(d) correcting the setting of the target power based on
10 the effected drive restriction, in the case of effectuation
of the drive restriction of said motor; and

(e) controlling said internal combustion engine, said
electric power-mechanical power input-output module, and said
motor in the case of no effectuation of the drive restriction
15 of said motor to ensure output of the target power from said
internal combustion engine and output of a power corresponding
to the setting of the power demand to said drive shaft, while
controlling said internal combustion engine, said electric
power-mechanical power input-output module, and said motor in
20 the case of effectuation of the drive restriction of said motor
to ensure output of the corrected target power from said
internal combustion engine and output of a power in a range
of the effected drive restriction from said motor.

16. A control method in accordance with claim 15, said
25 control method further comprising, prior to said step (d), the
steps of:

(f) measuring a charge-discharge electric power used to charge said accumulator or obtained by discharging said accumulator; and

(g) setting an electric power demand for charging or discharging said accumulator, based on a predetermined charge-discharge condition,

wherein said step (d) corrects the target power to cancel a difference between the observed charge-discharge electric power and the setting of the electric power demand.

10 17. A control method for an automobile, which comprises: an internal combustion engine; an electric power-mechanical power input-output module that is linked with an output shaft of said internal combustion engine and with a drive shaft coupled with an axle and outputs at least part of power from said internal combustion engine to said drive shaft through
15 inputs and outputs of electric power and mechanical power; a motor that is capable of inputting and outputting power to and from said drive shaft; and an accumulator that is capable of supplying and receiving electric power to and from said
20 electric power-mechanical power input-output module and said motor,

said control method comprising the steps of:

(a) setting a power demand required to said drive shaft, in response to an operator's manipulation;

25 (b) setting a target power to be output from said internal combustion engine, based on the setting of the power demand;

(c) when a predetermined restricting condition is fulfilled, effecting a drive restriction of said motor based on the predetermined restricting condition;

(d) correcting the setting of the target power based on
5 the effected drive restriction, in the case of effectuation of the drive restriction of said motor; and

(e) controlling said internal combustion engine, said electric power-mechanical power input-output module, and said motor in the case of no effectuation of the drive restriction
10 of said motor to ensure output of the target power from said internal combustion engine and output of a power corresponding to the setting of the power demand to said drive shaft, while controlling said internal combustion engine, said electric power-mechanical power input-output module, and said motor in
15 the case of effectuation of the drive restriction of said motor to ensure output of the corrected target power from said internal combustion engine and output of a power in a range of the effected drive restriction from said motor.

18. A control method in accordance with claim 17, said
20 control method further comprising, prior to said step (d), the steps of:

(f) measuring a charge-discharge electric power used to charge said accumulator or obtained by discharging said accumulator; and

25 (g) setting an electric power demand for charging or discharging said accumulator, based on a predetermined

charge-discharge condition,

wherein said step (d) corrects the target power to cancel a difference between the observed charge-discharge electric power and the setting of the electric power demand.